

# PATENT SPECIFICATION

421,482

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## PROVISIONAL SPECIFICATION

### Improvements in or relating to Ankle Joints for Artificial Limbs

I, CHARLES LANDER, of 56, Parkvale Road, Karori, Wellington, in the Dominion of New Zealand, a British Subject, Artificial Limb Expert, do hereby declare the nature of this invention to be as follows:—

This invention relates to improvements in artificial limbs of the type having hollow shin pieces and a flexible ankle joint and foot attached thereto.

It is known to construct artificial limbs in which the foot portion thereof is provided with an ankle joint wherein a limited amount of lateral movement is available, but such constructions employ a ball and socket joint to permit such movement, and which joint by reason of its positioning gives a metal to metal connection and therefore becomes noisy in use and gives little resiliency and comfort to the wearer of the foot, even when a damping pad of resilient material is employed.

It is also known to use resilient pads inserted between the bottom of the ankle tray and the top of the artificial foot, whereby a very limited amount of lateral movement is given to the said foot, but there is an objection to such a construction in that the necessary rigidity between the ankle tray and the foot is not always attained, and the said pads, by reason of constant friction, become quickly worn thus causing a looseness in the said parts.

The object of the present invention is to effect certain improvements in the ankle joint and the foot of an artificial limb whereby a better joint action is assured, and the natural lateral movement of the foot combined with the usual Plantar and Dorsal flexion thereof is provided for the wearer of the said leg.

A further object of the invention is to provide an improved ankle joint wherein the necessary degree of frontal and lateral movement and resiliency is attained as will permit the foot of the artificial limb to more readily conform to irregular surfaces and prevent loss of balance by the wearer of the limb.

A still further object of the invention is to provide means whereby strain on various parts of an artificial limb is

eliminated thus allowing the limb to be made of lighter material than in the case of it being provided with a fixed ankle joint, and also relieving the amputated stump of the limb (especially long below the knee stumps) of considerable strains. The usual jar and dull thud is avoided when the heel of an artificial limb fitted with my invention is placed on the ground when walking.

Accordingly, the invention comprises a specially designed metal ankle tray made of a strong yet light material, a case hardened steel or phosphor bronze detachable socket member fitted with a cap piece, a steel bolt threaded on one end and provided with a nut, and a shoulder formed on the stem of the bolt near its other free end, and which free end is formed into a ball head adapted to fit within the said socket piece, and rubber or such like resilient members of any approved shape and size adapted to be placed either transversely, longitudinally, or vertically in suitably positioned bearings in the said foot, and/or ankle tray, on either side of the said bolt and its socket piece when same are in position in the ankle tray and the foot. Alternatively, in place of the said ball-headed steel bolt I may use a specially designed U-shaped bolt in combination with a U-shaped socket member therefor.

Describing more particularly the construction of my invention as applied to an artificial foot which is provided with a movable toe hinged to the said foot and a lateral rubber pad inserted in said hinged portions. The heel of the said foot is recessed to receive the known type of cylindrical shaped vertical heel rubber pad. This recess is extended towards the front of the foot and in the preferred type the said recess is shallow immediately forward of the heel portion of the foot and is further recessed to form a pair of socket bearings for two solid rubber balls upon which an ankle tray of the design hereinafter described moves when placed in position within the foot and permits weight bearing thrusts of the limb to be transmitted to the said rubber balls thus eliminating jars and noise when walking.

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The recess in which the rubber balls are placed is again deepened in a forward direction so as to receive an instep resilient pad comprising a hard rubber portion and a soft rubber portion of greater depth when in its normal uncompressed position than the said hard portion. This pad assists the natural movement of the said ankle joint as the soft portion of the pad by reason of its size is in contact with the under surface of the ankle tray when weight is applied to the heel of the artificial foot, and the soft portion of the pad is adapted to be compressed to the level of the hard portion when the weight of the user of the artificial limb comes on to the sole of the artificial foot, thus eliminating any jar to the wearer of the limb caused through the frontal portion of the ankle tray losing contact with the hard portion of the instep resilient pad when weight is applied to the heel of the foot as in ordinary walking.

A centrally disposed hole is provided in the artificial foot and a recess is also made inwardly from the underside of the foot for the purpose of housing a steel bolt provided with a threaded end on which is a tightening nut. The said bolt is shouldered to enable it to be firmly and rigidly secured to the foot and the free projecting end of the bolt is formed with a ball for the purpose to be hereinafter described.

The hereinmentioned ankle tray is made of a light cast metal which will enable said tray to be light and strong, and the tray is socketed to receive the upper end of the instep resilient pad and is also recessed to form socket bearings for the said solid rubber balls. The ankle tray is fitted with a phosphor bronze or cast steel detachable socket piece which is secured to the said tray by screws. The lower end of the said socket piece is cast, machined, and slightly tapered to fit within the ankle tray and so forms a universal socket joint for the ball head of the said steel bolt.

A cap is screwed in the top of the said socket piece and a compressed spring may be inserted therein to ensure that the ball head of the bolt will be held normally in the lower portion of the said socket piece, and this space may be also used for the insertion of oil saturated cotton waste or other material to permit easy movement of the said ball head in its socket.

This construction forms a dust proof and self oiling socket.

It will be understood that this construction permits the ball head of the bolt to move freely in its socket piece as the hereinbeforementioned rubber balls or pads become compressed when weight is applied to the foot, thus this type of ball and

socket joint is different to previously known joints used in artificial limb construction in that my construction eliminates all direct weight on the bolt, its ball head, and its socket piece, as the space provided between the top of the ball head of the bolt and the inner face of the said cap member is sufficient to permit the rubber and other resilient balls and pads situated in the artificial foot to be compressed with a maximum degree without undue strain and friction being placed on the ball head of the said bolt and the inner face of the said socket piece, thus in effect permitting a floating action of the said ball head of the bolt within its socket piece.

The ball head of the bolt may be turned down to leave a central pin which is screwed to receive a semi-spherical shaped piece of leather and this construction is for the purpose of avoiding any noise which may occur through contact of the ball head of the bolt and the inside walls of its socket piece.

A modification of the means for joining the artificial foot to the hereinbeforementioned ankle tray is provided by the use of a U bolt in place of the hereinmentioned ball headed bolt and its socket piece. This U bolt has shoulders and is also provided with a bush or bearing piece of suitable metal which is adapted to bear on the pin of a U-shaped metal socket piece which is fitted in a suitably shaped recess in the said ankle tray and secured thereto by screws. The top portion of the said U bolt may be slightly tapered for the purpose of permitting a space between it and the inner walls of its metal socket piece so that a frontal, rearward, and lateral movement of the artificial foot is permitted.

The provision of the said bush and pin permits the nuts on the end of the said U bolt to be tightened up to the greatest necessary strain without altering the tension on the movable ankle joint.

In a further construction the front recess in the artificial foot is fitted with only one rubber pad and the beforementioned two separate rubber balls positioned within the artificial foot are replaced by two balls integral with a flat pad, in this modification the said pad is of softer rubber than the balls.

In a still further modification of the invention the first mentioned two rubber balls are replaced by a cylindrical rubber strip integral with a flat pad. In each case a hole is provided for the insertion of the retaining bolt.

It is thought that the construction and manner of operating my device will be apparent, and while the nature of the in-

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vention has herein been described, it is to be understood that the structural elements thereof are susceptible to variations and modification as fall within the ambit of this my invention.

Dated this 28th day of June, 1933.  
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15, South Street, London, E.C.2.,  
Agents for the Applicant.

## COMPLETE SPECIFICATION

### Improvements in or relating to Ankle Joints for Artificial Limbs

I, CHARLES LANDER, of 56, Parkvale Road, Karori, Wellington, in the Dominion of New Zealand, a British Subject, Artificial Limb Expert, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention is for improvements in or relating to ankle joints for artificial limbs.

It is known to construct artificial limbs in which the foot portion thereof is provided with an ankle joint wherein a limited amount of lateral movement is available, but such constructions employ a ball and socket joint to permit such movement, and which joint by reason of its positioning gives a metal to metal connection and therefore becomes noisy in use and gives little resiliency and comfort to the wearer of the foot, even when a damping pad of resilient material is employed.

It is also known to use resilient pads inserted between the bottom of the ankle tray and the top of the artificial foot, whereby a very limited amount of lateral movement is given to the said foot, but there is an objection to such a construction in that the necessary rigidity between the ankle tray and the foot is not always attained, and the said pads, by reason of constant friction, become quickly worn, thus causing a looseness in the said parts.

An object of the invention is to effect certain improvements in the ankle joint and the foot of an artificial limb whereby a better joint action is assured, and the natural movement of the foot combined with the usual Plantar and Dorsal flexion thereof is provided for the wearer of the said leg.

A further object of the invention is to provide an improved ankle joint wherein the necessary degree of frontal and lateral movement and resiliency is attained as will permit the foot of the artificial limb to more readily conform to irregular surfaces and prevent loss of

balance by the wearer of the limb.

A still further object of the invention is to provide means whereby the strain on various parts of an artificial limb is eliminated thus allowing the limb to be made of lighter material than in the case of it being provided with a fixed ankle joint, and also relieving the amputated stump of the limb (especially long below the knee stumps) of considerable strains. The usual jar and dull thud is avoided when the heel of an artificial limb fitted with my invention is placed on the ground when walking.

According to the invention there is provided an ankle joint for use in an artificial limb comprising an ankle tray formed of a strong and light material and provided with a socket member secured thereto, a bolt extending through an artificial foot and arranged to form a universal joint with said socket member and two resilient members of circular section disposed one on each side of said bolt transversely of the foot, so as to form a resilient support allowing lateral movement of the ankle tray with respect to the foot when the limb is in use.

The invention will be hereinafter more particularly described with reference to the accompanying drawing in which:—

Figure 1 illustrates a sectional elevation of the invention showing the preferred form of ankle joint,

Figure 2 illustrates a cross sectional elevation on line 2—2 in Figure 1 showing the component parts of the invention,

Figure 3 illustrates a section of a ball headed bolt wherein the upper half of the ball head consists of leather.

Figure 4 illustrates a modification of the invention in which a U bolt and its socket member are substituted for the ball headed bolt and its socket member shown in Figures 1, 2 and 3,

Figure 5 illustrates an elevation of the U bolt shown in Figure 4 together with its bearing,

Figure 6 illustrates an alternative type of resilient pad designed to replace the pair of rubber balls shown in Figures 1 and 2,

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Figure 7 illustrates an end elevation of the member shown in Figure 6,

Figure 8 illustrates a further alternative form of a resilient pad wherein a pair of spherical shaped balls are integral with the flat portion of the pad,

Figure 9 illustrates a part cross sectional elevation on the line 9-9 in Figure 2: the type of resilient pad as shown in Figure 8 being adapted herein.

Figure 10 illustrates a cross sectional elevation of a modification of the invention for use with a wooden leg.

Referring to Figure 1 of the drawing, the artificial foot 1 and toe 2, provided with the lateral rubber pad 3, and hinge 4, are of the usual type. The heel 5 of the foot is recessed at 6 to receive a known type of cylindrical shaped vertical heel rubber pad 7. The recess 6 is extended towards the front of the foot 1, the depth of the said recess being adapted to suit the design. In the preferred type the said recess 6 is shallow at 8 and is further recessed at 9 to form a pair of socket bearings for two solid rubber balls 10 fitted preferably in position shown in Figures 1, 2 and 4 of the drawings. As will be hereinafter seen, the ankle tray 18 when in position moves upon these balls and permits weight bearing thrusts of the limb on the foot to be transmitted to said balls thus eliminating jars and noise when walking.

The said recess 6 is deepened again at 11 to receive an instep resilient pad comprising a hard rubber portion 12 and a soft rubber portion 13 of greater depth when in its normal uncompressed position than the said portion 12. This pad assists the natural movement of the ankle joint, as the soft portion 13 of the said pad by reason of its size is in contact with the undersurface of the ankle tray 18 when weight is applied to the heel 5 of the foot 1, and the pad 13 is adapted to be compressed to the level of the hard portion 12 when the weight of the user of the limb comes on to the sole of the foot, thus eliminating any jar to the wearer of the limb caused through the frontal part of the ankle tray losing contact with the portion 12 of the instep rubber when weight is applied to the heel as in ordinary walking.

A hole 14 and a recess 15 are also provided in the foot 1 for the insertion of a steel bolt 16 provided with a threaded end on which is a tightening nut 17. The said bolt 16 is shouldered at 17A to enable it to be firmly and rigidly secured to the foot in the positions shown in the drawings, and the free end of the bolt is formed with a ball head 17B for the purpose hereinafter described.

The ankle tray is made of a light cast metal such as the substance known under the Registered Trade Mark "Duralumin" which will enable said tray to be light and strong, and is socketed at 19 to receive the upper end of the said rubber pad 7, and is also recessed to form socket bearings for the said solid rubber balls 10.

This tray 18 is fitted with a phosphor bronze or case hardened steel detachable socket piece 20 preferably of the construction shown in the drawings and which socket piece is secured to the said tray 18 by screws 21. The lower end 22 of the socket piece 20 is cast, machined and slightly tapered to fit within the tray 18, and so forms a universal socket joint for the ball head 17B of the said bolt 16. A cap 24 is screwed in the top of socket piece 20 and a compressed spring 25 may be inserted within the socket piece to ensure that the ball head 17B of the bolt will be held normally in the lower portion of the said socket. The space 26 is used for the insertion of oil saturated cotton waste or other oiling material to permit easy movement of said ball head in its socket. This construction forms a dust proof and self oiling socket.

It will be noticed that this construction permits the said ball head 17B to move freely in the socket piece 20 as the beforementioned rubber balls or pads become compressed when weight is applied to the foot: thus this type of ball and socket joint is different from previously known joints used in artificial limb construction in that the construction eliminates all direct weight on the bolt 16, the ball head 17B, and the socket piece 20, as the space 26 provided between the top of the said ball head 17B and the inner face of the cap member 24 is sufficient to permit the rubber and other resilient balls and pads situated in the foot to compress to the maximum degree without undue strain and friction being placed upon the ball head 17B and the inner face of the said socket piece 20, thus in effect permitting a floating action of the said ball head within the socket piece.

Figure 3 illustrates a section of a ball 28 which may be used as an alternative to the ball head 17B provided on the bolt 16. The upper half of the ball 28 consists of a hemisphere 30 of leather which screws on to a bolt 29 formed integral with the lower half of the head.

In Figures 4 and 5 which show a modification of the means for joining the foot to the ankle tray, a U bolt is employed in place of the said bolt 16, and this bolt 31 has shoulders 17A for the purpose previously explained, and is also

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provided with a bush or bearing piece 32 of suitable metal which is adapted to bear on the pin 33 of a U-shaped metal socket piece 34 which is fitted in a suitably shaped recess in the said ankle tray 18, and secured thereto by screws 35. It will be noticed that the top portion of said U bolt 31 is slightly tapered for the purpose of providing a space between it and the inner walls of the metal socket piece 34 so that a frontal, rearward, and lateral movement of the foot 1 is permitted. The provision of the said bush 32 and pin 33 permits the nuts 17 on the end of the U bolt 31 to be tightened up to the greatest necessary strain without altering the tension on the movable joint.

In the construction shown in Figure 9, the recess 11 in the foot 1 is fitted with only one rubber pad 36, and the two separate rubber balls 10 are replaced by two balls 37 integral with a flat pad 38, a cross section of which is shown in Figure 8. In this modification the pad 36 is formed of softer rubber than the balls 37.

In Figures 6 and 7 a further modification is shown wherein the two spherical balls 37 illustrated in Figure 8 are replaced by a cylindrical rubber strip 39 integral with the flat pad 40. In each case a hole 41 is provided for the insertion of the bolt 16. In Figure 10 which illustrates a modification of the invention for use with a wooden leg, the socket piece 42 is lengthened to extend through the tray 43 and the hardwood block 44. Screws 45 are provided to secure the socket 42 to the tray 43. A plug 46 of the substance known under the Registered Trade Mark "Duralumin" has an air hole 47 to prevent any vacuum being formed in the socket piece 42. The space 48, within the socket 42 is designed to be filled with oily waste for lubrication purposes.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. An ankle joint for use in an artificial limb comprising an ankle tray formed of a strong and light material and provided with a socket member secured thereto, a bolt extending through an artificial foot and arranged to form a universal joint with said socket member and two resilient members of circular section disposed one on each side of said bolt transversely of the foot, so as to form a resilient support allowing lateral movement of the ankle tray with respect to the foot when the limb is in use.

2. An ankle joint for use in an arti-

cial limb comprising the combination of a standard type of artificial foot with a metal ankle tray made of a strong and light material, a case hardened steel or phosphor bronze detachable socket member arranged to be attached to the said metal ankle tray, a steel retaining bolt threaded at one end and provided with a tightening nut for joining together the said artificial foot and the metal ankle tray, a shoulder formed on the stem of the bolt near the other end thereof which is formed into a ball head adapted to fit within the space provided in said detachable socket member, and rubber or like resilient members of circular section disposed transversely of the foot on opposite sides of the bolt so as to form a resilient support allowing lateral movement of the ankle tray with respect to the foot when the limb is in use.

3. An ankle joint as claimed in Claim 2, wherein the artificial foot of known type is provided with a series of recesses or bearings to receive a rubber heel pad, the steel ball headed bolt, the resilient members disposed on opposite sides of said bolt, and a resilient instep pad comprising a hard rubber portion and a soft rubber portion of greater depth when in its normal uncompressed position than the said hard rubber portion.

4. An ankle joint as claimed in Claim 1 or Claim 2, wherein the ankle tray comprises a light metal casting provided with a socket on the undersurface thereof for receiving the upper end of a heel pad, with sockets forming bearings for the said resilient members disposed on opposite sides of the said bolt, and also with an orifice which permits the housing of the said socket member when same is in position on the ankle tray.

5. An ankle joint as claimed in Claim 2, in which the upper half of the ball head consists of a hemisphere of leather or like material which is arranged to screw on to a pin formed integral with the lower half of the ball head.

6. An ankle joint as claimed in Claim 1, wherein the bolt and the socket member are constructed, arranged and adapted to operate substantially as hereinbefore described with reference to Figures 4 and 5 of the accompanying drawings.

7. An ankle joint as claimed in Claim 2, wherein the rubber or like resilient members are substantially of the form illustrated in Figures 2, 6, 7, 8 and 9 of the accompanying drawings.

8. An ankle joint as claimed in Claim 2, wherein a space between the top end of the ball headed bolt and the inner surface of a cap for the said socket member is utilised to house a coiled spring and

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an oil saturated material, for the purpose described.

9. An ankle joint for use in an artificial limb constructed, arranged and adapted to operate substantially as hereinbefore described with reference to the

accompanying drawings.

Dated this 29th day of June, 1931.

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Agents for the Applicant.

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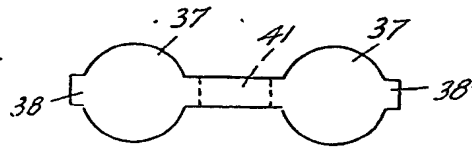


FIG. 8.

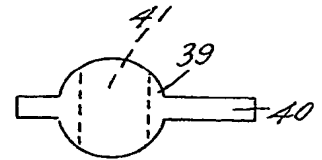


FIG. 7.

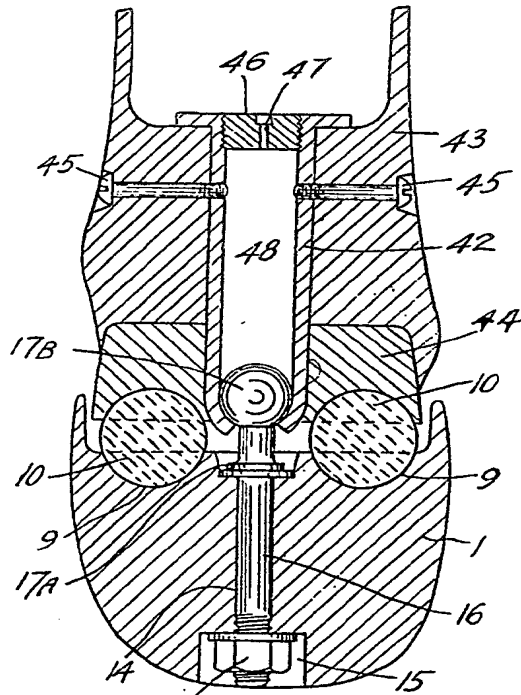


FIG. 10.

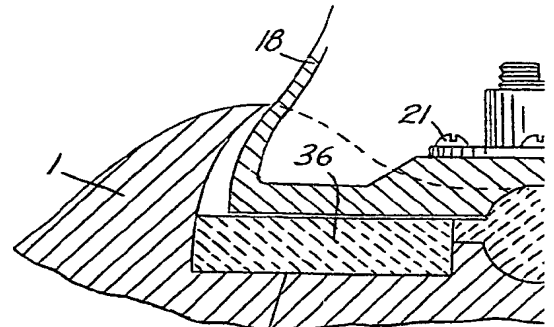


FIG. 9.

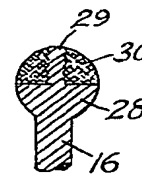


FIG. 3.

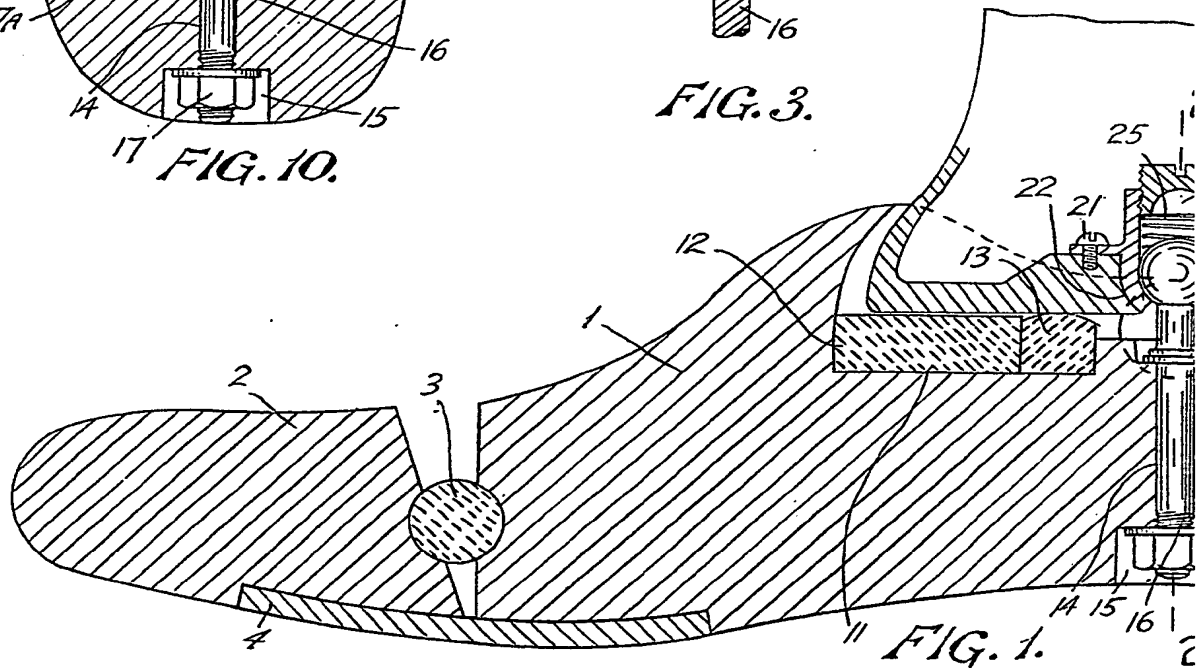


FIG. 1.

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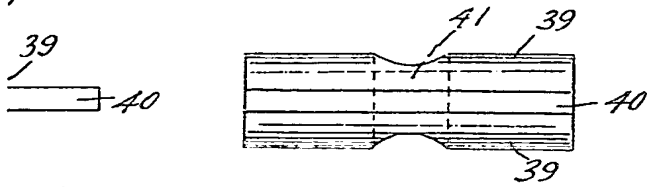


FIG. 6.

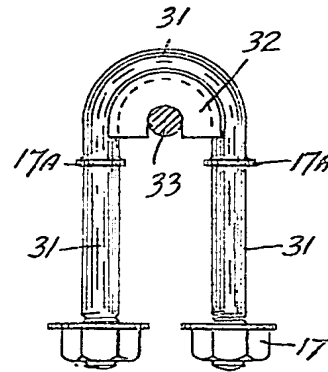


FIG. 5.

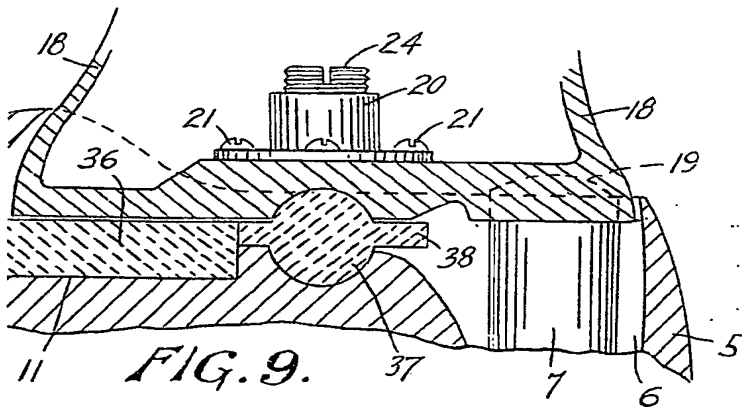


FIG. 9.

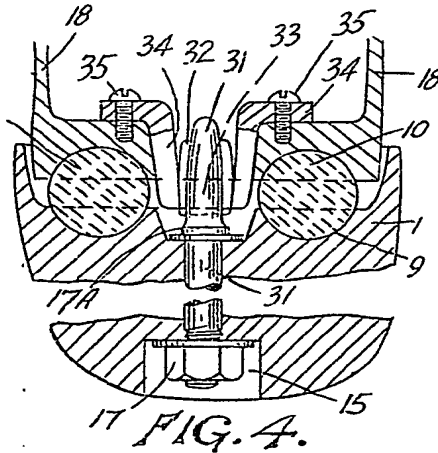


FIG. 4.

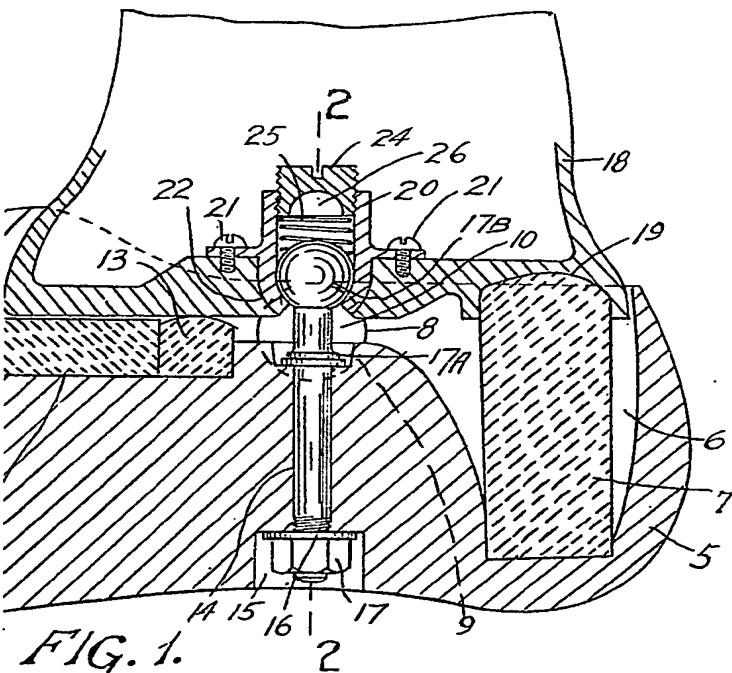


FIG. 1.

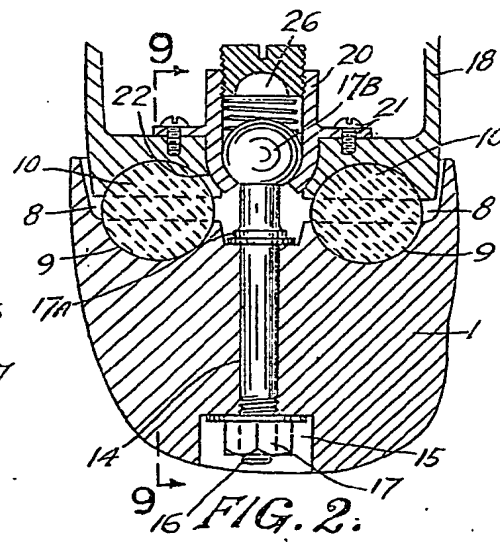


FIG. 2.

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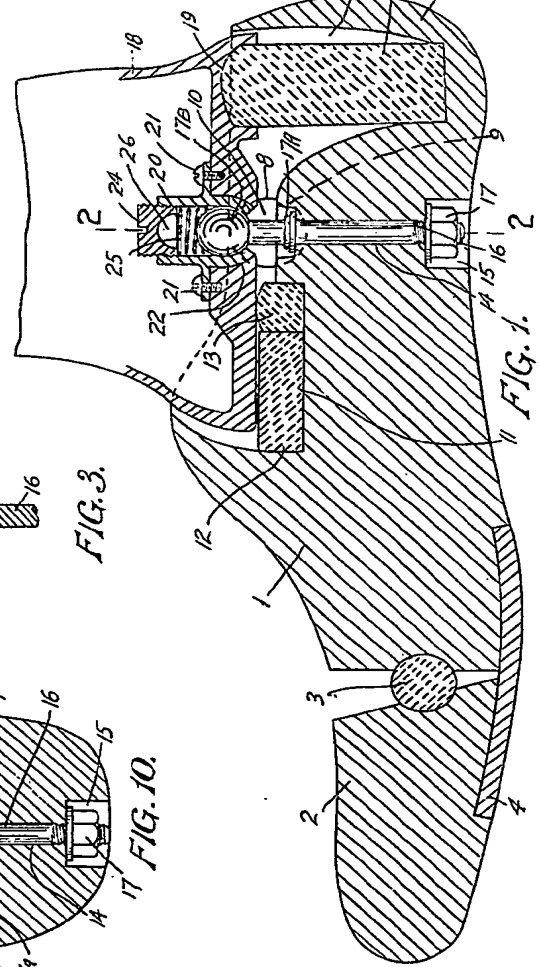
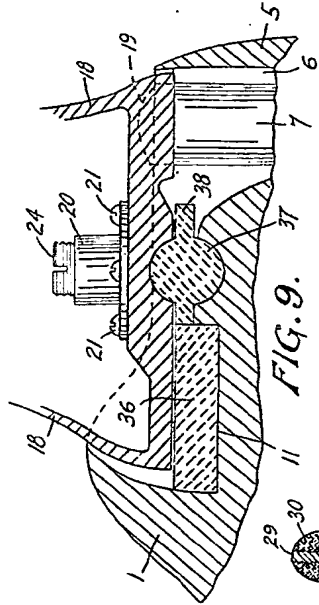
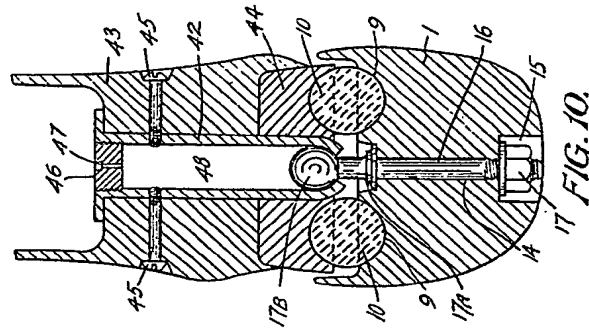
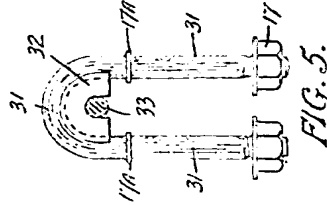
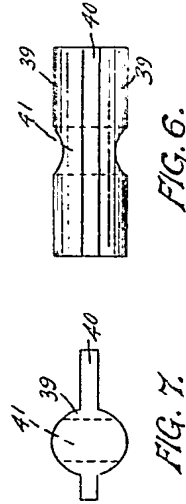
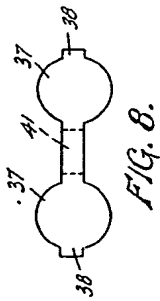
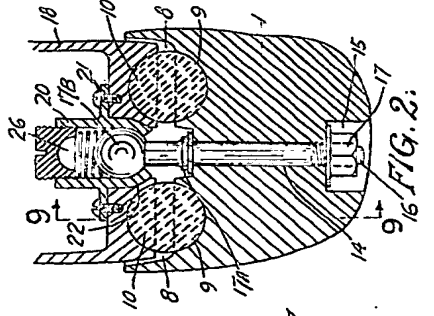
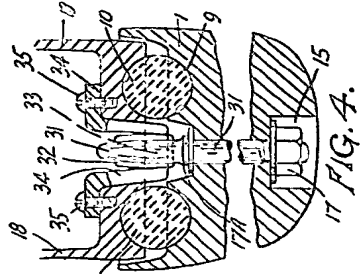


FIG. 3.



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